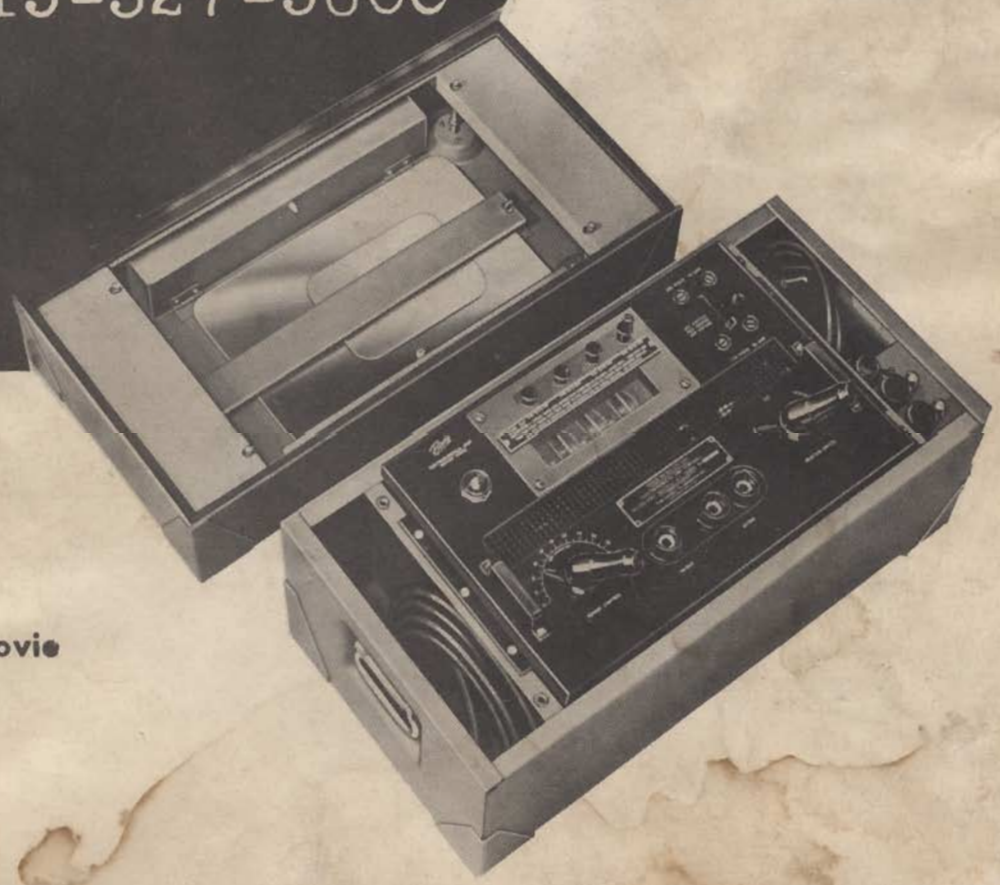
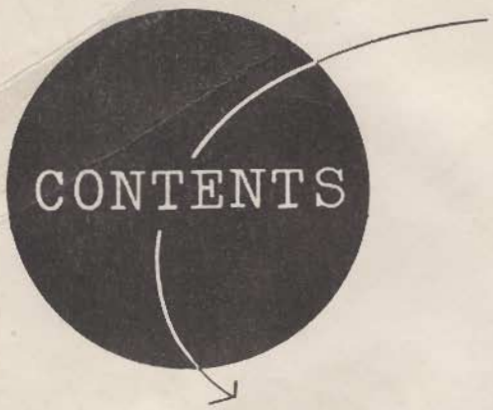
TECHNICAL MANUAL

ELECTROSURGICAL UNIT.
PORTABLE
STOCK NO. 6515-327-5600



The Military Bovie
LF 210LO501

LIEBEL-FLARSHEIM CO. • CINCINNATI, OHIO, U. S. A.
DIVISION OF RITTER COMPANY, INC. ROCHESTER 3, NEW YORK



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SECTION I - GENERAL

1. SCOPE
   This manual is published for the information and guidance of all persons concerned with the operation and maintenance of the L-F Military Bovie Unit (Electrosurgical Unit, Portable- Stock No. 6515-327-5600). This manual contains information relating to unpacking, assembly, operation and maintenance of the unit, and also includes a wiring diagram and parts list.

2. DESCRIPTION
   The L-F Military Bovie Unit is a spark-gap type electrosurgical apparatus, producing two types of high frequency currents in the one machine. One current generated is a slightly damped cutting current, and the other is a highly damped current for coagulation. A single selector switch allows instant change from one type of current to the other without releasing the electrode in hand. A single Power Control permits adjustment of output current continuously from zero to maximum. A footswitch completes the control system. The unit is mounted in a compact metal case, containing compartments to hold all accessories.

3. PERTINENT DATA:
   a. This unit is designed to operate on either 115-volts 14 amperes, or 230-volts 7 amperes, 50/60-cycles. The line voltage switch must be set correctly for the voltage used.

   b. Manufacturer -- The Liebel-Flarsheim Company, Cincinnati, Ohio, U.S.A., Division of Ritter Company, Inc.

4. ASSEMBLIES
   The Electrosurgical Unit, Portable (Stock No. 6515-327-5600), consists of the Electrosurgical generator enclosed in the metal carrying case (Fig. 1), complete with line cord and footswitch (Fig. 2) stored in the side compartments. Accessories (Fig. 3) are also stored in the side compartments and in the cover.

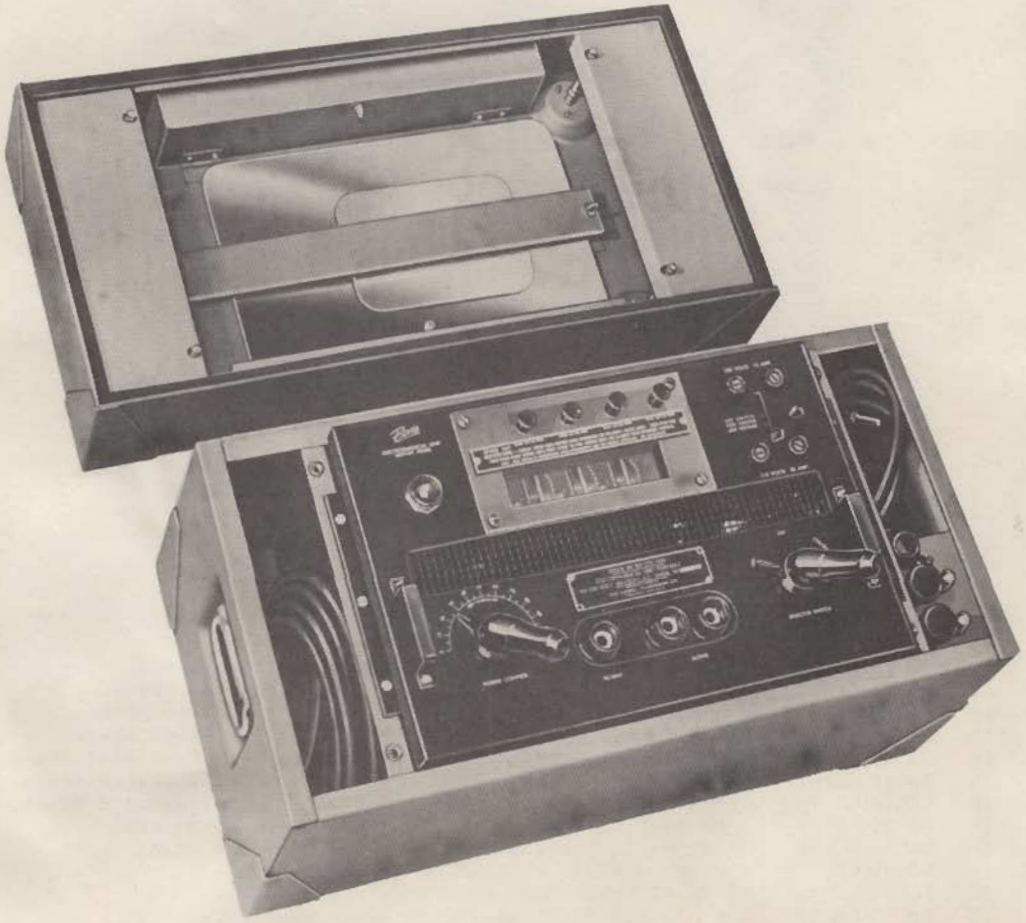


Figure 1

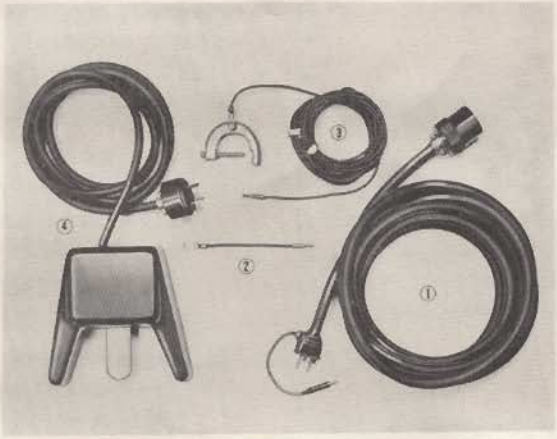


Figure 2

1. LF 210 LO 302 CABLE, LINE, 15 Ft.
2. LF 306 L 334 LEAD, GROUNDING, SHORT
3. LF 306 LO 333 LEAD, GROUNDING, LONG
4. LF 16 LO 127 FOOTSWITCH, SINGLE TREADLE

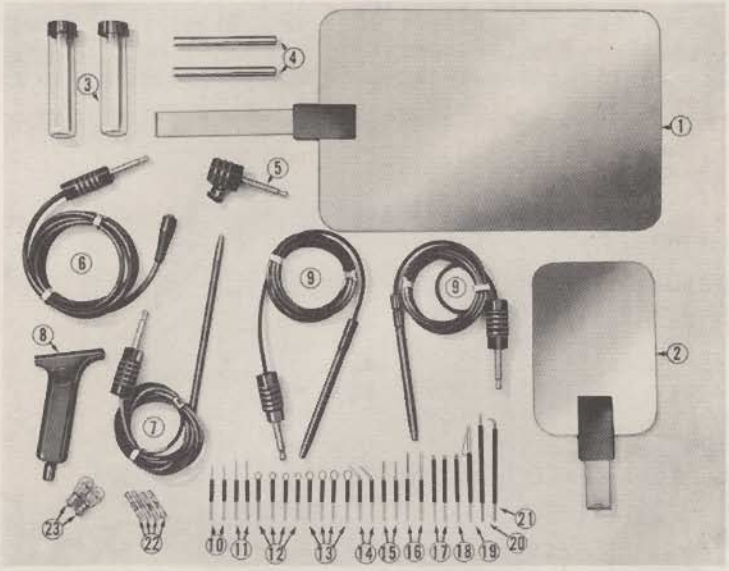


Figure 3

1	LF 15 LO 532	Large Stainless Steel Patient Indifferent Electrode.
2	LF 15 LO 531	Small Stainless Steel Patient Indifferent Electrode.
3	LF 210 L 387	Plastic Bottle.
4	LF 15 L 134	Sterilizable Handles.
5	LF 15 LO 210	Active Bovie Adaptor Plug.
6	LF 15 LO 94	Round End Patient Cord.
7	LF 15 LO 286	Long Chuck Type Handle.
8	LF 15 LO 288	Offset Grip for Long Chuck Type Handle.
9	LF 15 LO 105	Small Chuck Type Handles.
10	LF 15 LO 13	Fine Needle Electrodes with 7/8" Insulated Shank.
11	LF 15 LO 12	Coarse Needle Electrodes with 7/8" Insulated Shank.
12	LF 15 LO 44	1/4" Round Loop Electrodes with 7/8" Insulated Shank.
13	LF 15 LO 45	5/16" Round Loop Electrodes with 7/8" Insulated Shank.
14	LF 15 LO 503	Small Angulated Blade Electrodes with 7/8" Insulated Shank.
15	LF 15 LO 500	Small Straight Blade Electrodes with 7/8" Insulated Shank.
16	LF 15 LO 501	Large Straight Blade Electrodes with 7/8" Insulated Shank.
17	LF 15 LO 97	1/8" Ball Electrodes with 1-3/4" Insulated Shank.
18	LF 15 LO 98	3/16" Ball Electrode with 1-3/4" Insulated Shank.
19	LF 15 LO 338	Medium Cervical Conization Electrode.
20	LF 15 LO 423	Straight Point Stainless Steel Electrode.
21	LF 15 LO 426	3/8" Curved Point Stainless Steel Electrode.
22a	LF 44 L 128	10 amp. 250-volt Type 3AB fuses.
22b	LF 210 L 329	20 amp. 250-volt Type 3AB fuses.
23	LF 206 L 25	Pilot Lamp - 1/4-w, 120 volt. Candelabra base neon lamp.

SECTION II - UNPACKING AND ASSEMBLING

5. UNPACKING
To unpack the Electrosurgical Unit, proceed as follows:

a. Open shipping box carefully, remove wrapping so as to uncover case. Lift case from the shipping box.

b. The unit is packed in its carrying case assembled and ready for operation, except for plugging in electrical connections, adjusting the spark gaps and attaching accessories.

c. Remove cover by unscrewing the four captive wing screws on top of cover and lifting straight up.

d. Remove and unpack connecting cable, footswitch and other accessories, from side compartments, and from compartments in cover.

6. ASSEMBLING
To assemble, proceed as follows:

a. Check supply voltage and frequency and set line voltage selector switch on panel of unit to proper position corresponding to the line voltage you are using. DO NOT PLUG LINE CORD INTO SUPPLY LINE RECEPTACLE UNTIL YOU HAVE CHECKED LINE VOLTAGE AND FREQUENCY AND PROPERLY SET THE LINE VOLTAGE SELECTOR SWITCH.

b. The supply cable is stored in the left hand compartment of the case and may or may not be plugged into the electrosurgical unit. Connect female end to 3-prong twist-lock male receptacle in unit and connect male end of cord to supply receptacle of proper voltage and frequency.

c. The footswitch is stored in the right-hand compartment of the unit. Remove and plug into the 2-prong female receptacle of unit (located in the right-hand compartment). Plug may or may not be already connected to unit.

d. Spark gap adjustment should be made at this point. Refer to Section III, paragraph 9 for detailed information.

e. With all connections made, and the spark-gaps adjusted, the machine is ready for service. Refer to Section III, Paragraph 8 for detailed information on operating the machine.

7. DISASSEMBLING AND PACKING
To disassemble and pack, proceed as follows:

a. Disconnect supply cable and ground lead and pack in left-hand compartment. It is <u>not</u> necessary to disconnect cord from electrosurgical unit.

b. Store footswitch in right-hand compartment. It is <u>not</u> necessary to disconnect footswitch plug from the electrosurgical unit.

c. Disconnect other accessories.

d. Clean equipment thoroughly.

e. Store instruction book and indifferent electrodes against top of cover, placing instruction book against cover, large indifferent electrode next, small electrode next, and fastening in place with clamp bar.

f. Store all remaining cords and electrode handles in the two compartments in the cover. Secure compartments by turning latch a quarter turn.

g. Place electrodes in the plastic bottle and insert plastic bottle into its recess in the right-hand compartment.

h. Insert sterilizable handles in proper recesses in right-hand compartment of case.

i. Fasten cover on securely by placing into position and tightening the four wing screws, which are recessed in top of cover.

j. If unit is to be reshipped, pack case securely in wooden box using insulating material to prevent jarring in transit.

SECTION III - OPERATION

8. TO PLACE MACHINE IN OPERATION

a. To have apparatus ready for use merely requires that the supply cable and footswitch be connected; the spark gaps correctly adjusted; the patient and active electrodes connected; and the selector switch and power control properly set. These steps are covered in detail in the following paragraphs.

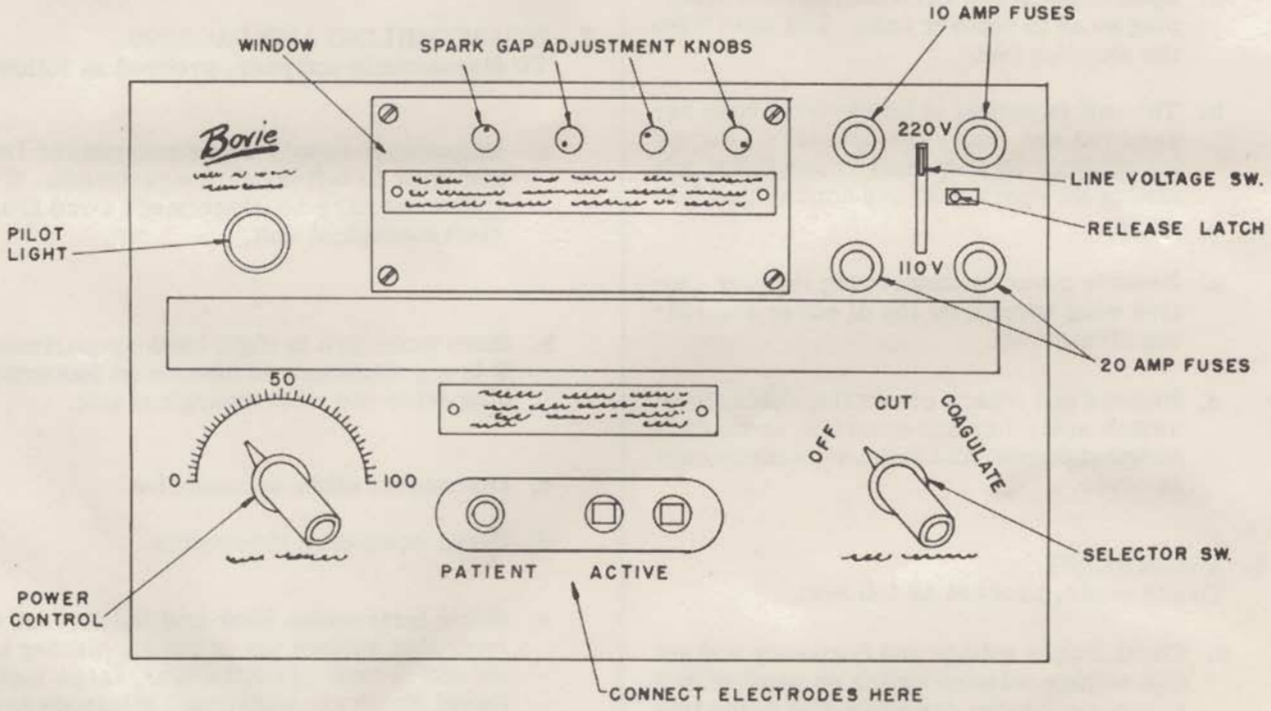


Fig. 4. Top View of Panel Showing Controls

(1) Set LINE VOLTAGE SWITCH to the position corresponding to the line voltage available. This will be either 115 or 230-volts and the frequency must be between 50 and 60-cycles. In case of doubt as to line voltage or frequency, have electrician check before connecting machine. DO NOT CONNECT TO DC OR 25-CYCLE AC, AS THIS WILL DAMAGE THE MACHINE. Note that the latch must be released by pressing small knob to the right, before line voltage switch can be shifted.

(2) Plug SUPPLY CABLE into an electrical outlet of proper voltage and frequency. Connect footswitch. Ground machine as per following paragraph:

(3) INSTRUCTIONS FOR GROUNDING. It is the accepted practice to ground all electrical apparatus housed in metal cabinets. Accordingly, a three wire supply cable is supplied; the third wire connects to the Bovie frame at one end and at the plug end is to connect to ground.

(a) Most modern wall box receptacles are grounded. To determine this, unscrew outlet box cover. If a pipe or BX flexible tubing is connected to the outlet box, the ground is satisfactory. It may be difficult to determine if wall box is grounded. Under such circumstances ground the cabinet as suggested under Fig. 7 until you can obtain definite information on this. Otherwise proceed as follows.

Fig. 5. SINGLE OUTLET RECEPTACLE WITH GROUND.

Near the end of the supply cable that plugs into wall terminals is a grounding wire. Pull out threaded end piece from this wire. Remove one of the screws from wall outlet plate and replace it with this

See illustration on next page.

threaded end piece. Then push sleeve on grounding wire over projecting end piece and supply cable is grounded.

Fig. 6. DOUBLE OUTLET RECEPTACLE WITH GROUND.

On this type of receptacle, use the short grounding lead included with grounding accessories, because the screw (as used with single receptacle) will be in the way of plugging in the supply plug. Remove the screw from the plate and slip it through the ring end of the grounding wire and replace, being sure to get a good metal-to-metal contact. Then slip the other end of the short wire into the supply cable ground connection, as illustrated.

Should there be any doubt about wall terminal box being grounded, use the method suggested below under Fig. 7 temporarily and then make inquiries about the wall box terminal.

Fig. 7. OUTLET RECEPTACLE WITHOUT GROUND.

Use a long ground lead and ground clamp. Fasten it securely to radiator, steam line or water pipe with the clamp, making sure of a good metal-to-metal contact. Plug the other end into grounding wire at end of supply cable. If gas-electric generator is used, connect to frame of generator (which should be grounded).

(4) Turn SELECTOR SWITCH TO "CUTTING."

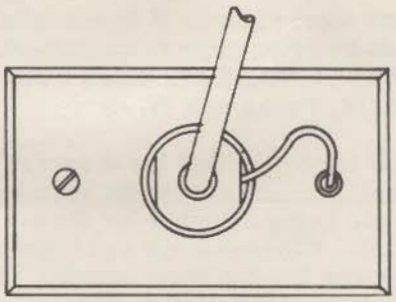


Fig. 5 SINGLE OUTLET RECEPTACLE WITH GROUND

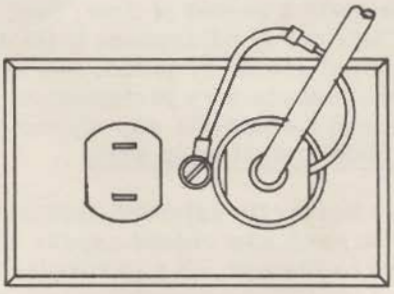


Fig. 6 DOUBLE OUTLET RECEPTACLE WITH GROUND.

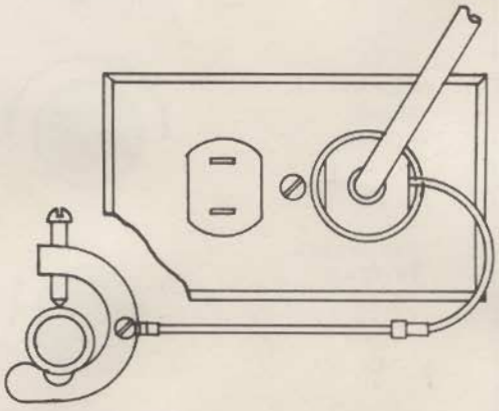


Fig. 7 OUTLET RECEPTACLE WITHOUT GROUND

9. ADJUSTING SPARK GAPS

a. Firing of the gaps may be observed through the transparent window. Immediately above each gap is its adjusting knob. Turning the knob clockwise closes the gap; counter-clockwise opens the gap.

As the quality of the current is dependent on spark gap adjustment, it is essential that this operation be accurately and properly performed. There is nothing difficult about the gap adjustment -- on the contrary, it is a rather simple procedure -- but it must be done just right to insure satisfactory performance.

b. TO ADJUST GAPS, first move Selector Switch to either the "Scalpel" or "Coagulation" position. Step on footswitch to start current flow through gaps. Then look at the gaps through the observation window, if any of the gaps are not firing, turn the proper adjusting knob (or knobs) counter-clockwise to open the gaps slightly until all

gaps start to fire. It is essential that all gaps be firing prior to adjustment. **IF UNABLE TO MAKE ALL GAPS FIRE, see Section IV, Paragraph 17. -b**

c. It is important that the observer's eye be lined up directly above the sparking surface of gap being adjusted for the arc is quite small. Close one eye and align the other eye with the gap being adjusted. Take each gap in turn from left to right.

d. For best performance, the gap adjustment should be made each day before operations are started. While the gaps will, under ordinary conditions, retain their adjustment over quite a period of time, they may get slightly out of adjustment if the machine is moved around or jolted, and for assurance of satisfactory performance, we recommend a complete gap adjustment each day before starting to work.

e. When correctly adjusted, intensity of the arc in each gap should appear about the same to the eye. If a particular gap appears to fire with less intensity than the others, it probably means that it has not been opened enough and should be completely readjusted in accordance with above instructions.

f. If any one gap fires irregularly or sputters, it very likely means that the gap needs readjustment because it has been opened too wide.

g. With the gaps properly adjusted, you will hardly hear the arc that takes place when the current is on. (Don't confuse the 60 cycle transformer hum with the high pitched hissing note of the arc). If one or more of the gaps are opened too wide, or if they are adjusted improperly, so that one takes most of the load, there will be a decided sputtering in that gap (or all gaps, if all are open too much). The sputter at rare intervals is of no consequence, but if heard often or continuously, all gaps should be correctly readjusted.

h. We have elaborated on this spark gap adjustment, not because it is difficult or complicated, but rather on account of its relative importance. Correct gap adjustment is essential to satisfactory operation, particularly of the cutting current. If the machine seems to lack cutting power -- if it cuts slowly -- or if there is excessive amount of dehydrated tissue on edges of the wound -- these are sure signs that the gaps are not in adjustment and they should be properly set before further use.

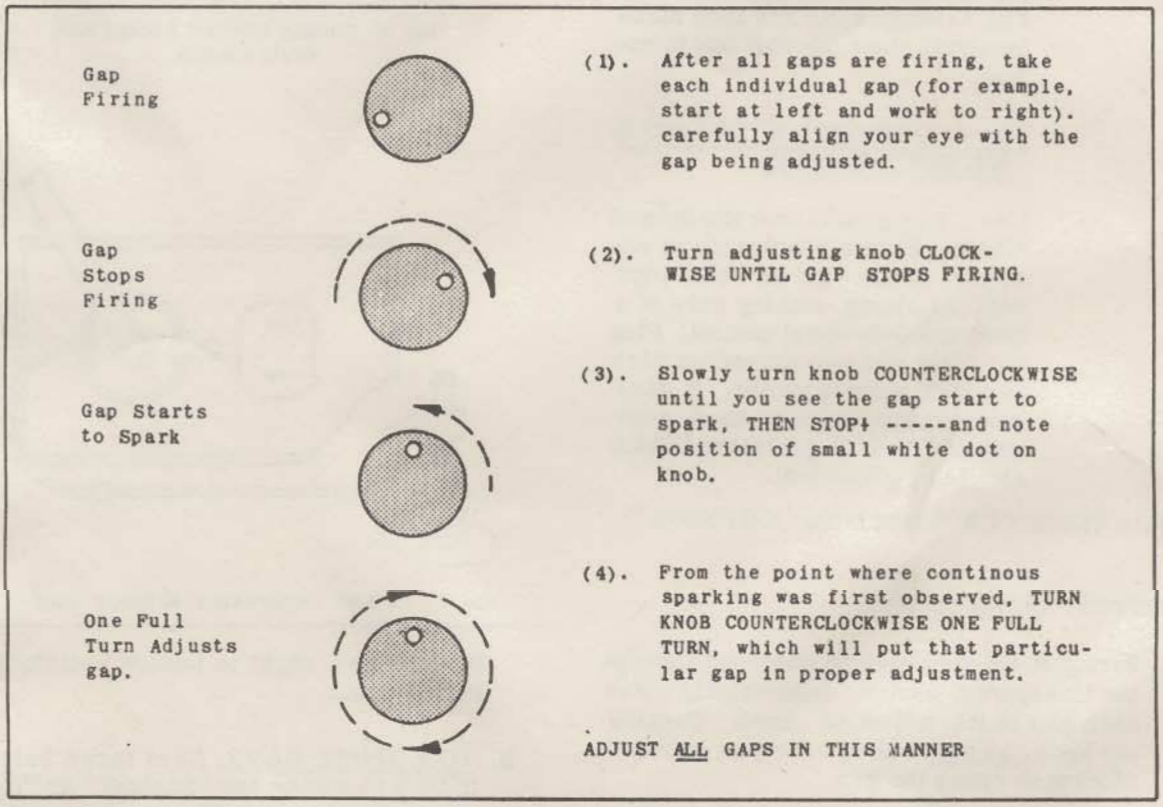

Gap Firing
Gap Stops Firing
Gap Starts to Spark
One Full Turn Adjusts gap.
(1). After all gaps are firing, take each individual gap (for example, start at left and work to right). carefully align your eye with the gap being adjusted.
(2). Turn adjusting knob CLOCKWISE UNTIL GAP STOPS FIRING.
(3). Slowly turn knob COUNTERCLOCKWISE until you see the gap start to spark, THEN STOP! -----and note position of small white dot on knob.
(4). From the point where continous sparking was first observed, TURN KNOB COUNTERCLOCKWISE ONE FULL TURN, which will put that particular gap in proper adjustment.
ADJUST ALL GAPS IN THIS MANNER

Figure 8

i. Remember these simple instructions.

✓ HAVE ALL GAPS FIRING BEFORE THE ADJUSTMENT IS STARTED.

✓ HAVE THE EYE LINED UP DIRECTLY WITH SPARKING SURFACE and catch the point where firing first begins. This is a critical factor in the adjustment. You must see the very first twinkle and then open the gap one full counterclockwise turn from the point where firing was first observed.

✓ ADJUST ALL GAPS EACH DAY BEFORE WORK IS STARTED. The Bovie gaps incorporate a unique, self-compensating feature which insures their continuous, satisfactory operation and consistent performance. When properly adjusted, the machine is brought to a condition of stability and, under equivalent conditions, results can always be duplicated -- you know in advance the results to be expected from a given power setting.

j. With the supply cable and footswitch connected and gaps properly adjusted, the machine is ready for service and you can connect INDIFFERENT ELECTRODE to the terminal marked "Patient", using the cord with clip on one end and round plug on other. The clip is fastened onto the metal indifferent plate. See Section III, Par. 11-a. for further information on applying indifferent electrode.

k. INSERT OPERATING ELECTRODES in Chuck Handle by unscrewing to release the chuck, inserting the electrode and then tightening chuck carefully.

l. INSERT terminal plug on the Chuck Handle cord into one of the terminals marked "Active Electrode".

10. STERILIZATION OF ELECTRODES AND ACCESSORIES

WHEN USED FOR ASEPTIC SURGERY, the various parts that require touching or handling during operation should be sterilized before they are connected. These include the chrome handles for Power Control and Selector Switch, the Chuck Handle and cord and the required operating electrodes.

With these parts sterilized, you are ready to insert STERILIZABLE HANDLES in openings in the power control and selector switch. Turn handle clockwise two or three turns to lock in place.

a. In preparing the Bovie Unit for aseptic surgery, all parts which are handled or touched in the course of an operation should be sterilized prior to use. These include the operating electrode handles with their cords; the sterilizable handles which fit into power control and selector switch; all needles, knives, loops, blades and other operating instruments.

b. The metal parts, including the loops, needles, knives, etc., can be sterilized by prolonged boiling or auto-claving without damage.

c. The bakelite handle and rubber cords are subject to some deterioration if subjected to prolonged heat sterilization and they will need replacement from time to time.

d. The useful life of the handles and cords can be lengthened by sterilization in some adequate cold solution, but we do not recommend cold sterilization in Neuro-Surgery, operation in the Thoracic Cavity, in the abdomen, etc., where immaculate conditions are essential.

e. In several institutions the operating handles and cords are wrapped in towels and sterilized in the autoclave for ten minutes at 20 pounds pressure. This is considered adequate for most major surgery and does not cause undue deterioration of the bakelite and rubber parts.

f. STERILIZATION OF RESECTION INSTRUMENTS. For Prostatic Resection instruments, the customary mercuric cyanide solution used for cystoscopes is recommended. Alcohol or phenol should not be used on the resection instruments as they may cause deterioration of some of the parts.

11. PRECAUTIONS

L-F Bovie Electrosurgical Units are sold only for use by qualified physicians and sur-

geons. The observance of safe and established medical practices is essential to their proper use, otherwise there are possibilities of injury to patients and operators.

a. PREVENTION OF HIGH-FREQUENCY SKIN BURNS. Burns are possible either from the indifferent electrode (if improperly prepared and applied) or from the active electrode if it is carelessly handled or laid on the patient when not in use.

(1) Be sure indifferent electrode is smooth and clean.

(2) To insure good contact between the patient and the indifferent electrode, the electrode and patient's skin should both have a generous application of heavy soap lather or K-Y Jelly, and under no circumstances should the electrode be applied over hair or hard scar tissues. Hair and scar tissue are non-conducting and may cause concentration of current at other points under the electrode.

(3) When not in use, the chuck handle and active electrode should be kept away from contact with patient, or a burn may result if footswitch is depressed.

b. PREVENTION OF BURNS RESULTING FROM ACCIDENTAL IGNITION OF INFLAMMABLE FLUIDS. When an inflammable fluid (such as alcohol) is used to cleanse the field preparatory to surgery, it is well to remember that there is a possibility of igniting any residual liquid by a spark from the electrode. When inflammable fluids or solvents are used, allow sufficient time for complete evaporation and be sure that dressings, coverings, clothing, etc., surrounding the field are not saturated with the liquid.

c. PREVENTION OF EXPLOSION FROM IGNITION OF INFLAMMABLE INHALANT ANAESTHETICS.

(1) The use of an electrosurgical unit imposes some limitations on the type of anaesthetics which can be safely used. Since electrocutting is done by means of an arc formed between the cutting electrode and the tissue and since coagulation may also involve a spark between electrode and tissue, choice of anaesthetics should be made with full consideration of the danger of using electric sparks in the presence of explosive gases.

(2) Some gases, such as ethylene, cyclopropane and vinyl ether, are so explosive in small concentrations that they should never be used with electrosurgery. Ether, while dangerous in the absence of proper precautions, can be used with reasonable safety by the "closed method" if the patient's head and the anaesthetist are separated from the operating field by moist drapes, if the operating room is continuously ventilated, and care is taken to prevent spillage and to immediately remove empty ether cans.

(3) It should be recognized, of course, that all commonly used inhalant anaesthetics are inflammable and especially so when used with oxygen. Therefore, caution is advised even when such "comparatively safe" gases as nitrous oxide and chloroform are used.

(4) No inhalant of even the slightest degree of inflammability should be used when there is any communication between the operating field and the respiratory passages.

(5) With present day techniques for administering spinal, intra-muscular, oral and rectal anaesthetics, together with the safer gasses, the surgeon has a wide choice from which to select an appropriate anaesthesia for any electrosurgical procedure.

12. POWER CONTROL SETTINGS FOR ELECTRO-CUTTING.

a. The single control at left front on the top panel varies the power of both cutting and coagulation currents. This control is effective when either current is turned on. Rotating through its graduated scale, it affords a constant, unbroken range of power from zero up to maximum output of the cur-

rent in use. The scale is purely arbitrary, indicating the relative current strength between minimum and maximum settings. The amount of power required for any given type of work -- either cutting or coagulation -- involves a number of variables so that in the end, experience and familiarity with the machine and the various electrodes will be of more value than any arbitrary figures we may set. However, if the fundamentals are thoroughly understood, the operator will, with a little experience, have no difficulty in arriving at the correct settings to use under different conditions.

b. CUTTING POWER REQUIRED IN GENERAL SURGERY will vary, depending on -

(1) Nature of tissue being sectioned. Fatty tissue or cartilage requires more power than skin or muscle tissue. Sclerotic, fibrotic or cicatricial tissue will require more power than softer structures.

(2) Depth of incision. A deep incision (with the same electrode and a given speed of cut) require more power than a shallow one.

(3) Rate of speed at which cutting electrode is moved. Fast cuts require more power than slow.

(4) Type of electrode used. For a given depth of incision with equivalent speed of cutting, the amount of power required will depend on the thickness of the electrode used. The thinner the electrode the less the power required.

c. With these fundamentals in mind, it can be seen that the power settings are not fixed arbitrary figures, subject to no variation. Rather the surgeon should learn that this is a flexible factor and that best results are secured by varying the power settings to meet the immediate conditions.

d. There is one safe general rule that applies to all conditions, namely,

USE THE LOWEST POSSIBLE POWER SETTING WHICH CUTS FREELY TO THE DESIRED DEPTH, WITH THE ELECTRODE IN USE.

This rule, if followed, will result in a minimum of sparking and flashing at the electrode -- will prolong the life of operating instruments -- will prevent charring or excessive coagulation of the wound edges.

e. As noted in the preceeding section b, variables prohibit recommending definite power settings for different conditions. These can be learned only by studying performance of the unit on actual operations, under your own conditions. However, it is feasible to give power ranges within which certain results can be secured. Using an indifferent electrode in all the following cases these settings will serve as a guide:

(1) Using the small flat blade, a power setting of 30 to 40 will permit fairly rapid incisions through skin or muscle, 1/8" to 1/4" deep.

(2) Settings between 35 and 45 will make rapid incisions up to about 1/2" deep.

(3) From 45 upward will cut rapidly the full depth of the small blade.

f. These settings apply to the use of the small flat blade. The large flat blade, the small needle, and the large needle require slightly more power in the order named. To cut the full depth of the large blade a power setting around 55 will be required. To cut the full depth of the large needle about 60 will be required.

g. With the smaller loop electrodes, around 35 to 45 will "scallop" small bits of tissue. From 45 to 55 will excise fairly large pieces of tissue and for big segments with the larger loop, from 55 upwards will be required.

h. *CERVICAL CONIZATION ELECTRODES* will require from 40 to 50 depending on depth the electrode is inserted and size of segment to be removed.

i. Remember that the above are not fixed arbitrary figures. They may vary if your line voltage is above or below normal. In a wet, bloody field, considerably more power may be required than in a drier tissue. Recall that fatty tissue or cartilage require more than skin or muscle. As actual work is done, experiment with different amounts of power and thus learn those settings giving best

results under your particular conditions. Experiments on meats as outlined in Paragraph 16 are very valuable and are highly recommended before work is started on the actual patient.

j. NOTE - Electro-cutting should always be done by the bipolar method; that is, a large indifferent electrode should be applied to the patient's bare skin. Under certain conditions, it is physically possible for the surgeon to cut without an indifferent electrode, but this is not recommended for general use. For a given depth of incision it requires a great deal more power to cut without an indifferent electrode (monopolar) than it does with the bipolar method. Also, if an indifferent electrode is not used, a direct current path is not provided through the patient and there might be a tendency for the current to "leak" out through the operator. For these reasons, we recommend that cutting always be done by the bipolar method.

13. UNDERWATER CUTTING

a. Underwater cutting requires electrodes with insulated shanks so that all current will be concentrated on the cutting area of the electrode. The uninsulated open-air electrodes will not cut under water because a large proportion of the cutting current will be dissipated into the water from the bare shank of the electrode. Therefore, do not expect to cut under water except with electrodes designed especially for that purpose. All electrodes supplied with this unit have insulated shanks (See Fig. 3.)

b. If the irrigating medium has a high mineral content, it will act as a short circuit and reduce the power available for cutting. If any difficulty is experienced with underwater cutting when the proper electrodes are used, change to distilled water.

14. POWER CONTROL SETTINGS FOR ELECTRO-COAGULATION AND DESICCATION

a. The amount of power required for this work varies widely and depends on:

(1) Size of electrode used.

(2) Area of electrode in contact with tissue.

(3) Depth and area of destruction desired.

(4) Length of time current is applied.

An understanding of the different conditions is necessary before power settings can be worked out.

b. ELECTRO-COAGULATION can be defined as a process in which a high frequency current is employed to actually "cook" tissue surrounding the active electrodes. Enough heat to do this is generated within the tissue by the current passing from the electrode into the surrounding tissue.

c. ELECTRO-DESICCATION is a procedure similar to electro-coagulation except, that active electrode is not placed in actual contact with tissue. Current is allowed to jump through space and, sparking onto the surface being treated, dehydrates the superficial layers of tissue.

d. These two methods of application produce exactly the same effect on tissue - namely - the cells so treated are dehydrated, or coagulated, or actually cooked - the difference being that contact coagulation penetrates more deeply, causes a greater depth of destruction -- whereas, desiccation affects only the superficial layers.

e. Both coagulation and desiccation can be done with or without an indifferent electrode. To denote these two conditions the following terms are used:

1. Monopolar when a single active electrode is used without an indifferent electrode.

2. Bipolar when an indifferent electrode is used for current return path.

These terms are used merely to indicate the method of applying current. There is no difference in the surgical effect of these currents or in their electrical characteristics. The difference is in the amount of power secured from a given setting. For a given power setting greater effect is obtained with bipolar applications than with monopolar.

f. MONOPOLAR DESICCATION -

Very light	-- 10 to 20
Light	-- 20 to 35
Medium	-- 35 to 50
Heavy	-- 50 upwards

g. BIPOLAR COAGULATION -
Very light -- 5 to 10
Light -- 10 to 20
Medium -- 20 to 35
Heavy -- 35 upward

h. BLADDER FULGURATION -
From 45 to 65, depending on size of tip and amount of destruction desired.

Settings shown above will apply when the current is used for tissue destruction.

i. For electro-hemostasis by the clamp and coagulation method, power requirements will vary considerably, depending on the size of the clamp used, the amount of tissue picked up, the size of the bleeder and other factors. In general, however, a power setting of around 35 (bipolar method) will prove adequate if only small amounts of tissue are picked up in the clamp and from 40 to 45 if larger clamps are used and larger bits of tissue picked up.

15. SPECIAL NOTES ON TRANSURETHRAL PROSTATIC RESECTION

a. As in all electrosurgical work, power settings for transurethral resection should be varied to best suit the immediate conditions.

b. It is always desirable to use the least power that will produce the desired results, i.e., use the lowest cutting power that resects freely on the particular gland being removed. Use the lowest coagulation power that will effectively control hemorrhage, remembering that the larger the bleeding vessel, the more power is required for quick control. The less power used, the longer the loops will last and the less tendency to char and carbonize the sheath.

c. In general, somewhere within the following power ranges will prove satisfactory:

28 Fr. McCarthy Electrotome --
Cutting Power - 65 to 95
Coagulation Power - 50 to 60

24 Fr. McCarthy Electrotome --
Cutting Power - 60 to 80
Coagulation Power - 40 to 50

d. It may be desirable to change power settings in the course of an operation. When starting to resect, it is advisable to use the lower power range and if easier cutting is desired, step up the power a few points at a time until it cuts freely.

e. For control of hemorrhage, a coagulation power setting around 45 will effectively control oozing or bleeding from the smaller vessels, but in the presence of large individual spurters, more power (around 55) should be applied for effective, rapid control. Really large bleeders require considerable power for quick control.

f. For sterilizing prostatic resection instruments, the customary mercuric cyanide solution used for cystoscopes is recommended. Alcohol or phenol should not be used on the resection instruments as they may cause deterioration of some of the parts.

g. If machine does not cut in prostatic resection, with all of the points checked as listed in Paragraph 17c, it may indicate --

(1) A defective loop; change loops immediately.

(2) The irrigating medium is of high chemical content. If in doubt, only distilled water should be used.

16. EXPERIMENTS ON MEATS

a. PRELIMINARY EXPERIMENTAL WORK
Before attempting actual electrosurgery, it is advisable to experiment with use of the machine on a piece of meat. This is an excellent way for the physician to acquaint himself with the action of the different currents, the control settings, manipulation of the footswitch and use of the various electrodes.

A generous-sized piece of veal, or a heart, is the most satisfactory for the purpose. The meat should be allowed to attain room temperature and should be fresh and moist. If necessary, it may be moistened by injection of a moderate amount of physiologic saline solution. The moisture content is important in order to simulate living tissue as closely as possible though the dead meat, in any case, cannot be entirely comparable.

b. EXPERIMENT WITH COAGULATION
Lay the piece of meat directly on an indifferent plate connected by means of the clip and connecting cord to the "patient" terminal of the Bovie unit. The active electrode handle is connected to one of the active terminals. Connect the footswitch and place it for convenient accessibility, turn the selector switch to "coagulation" and proceed as follows:

For the first experiment, use the straight-point coagulation electrode. Using a fairly heavy power setting (about 40 percent of total), insert the electrode into the meat to a depth of about a quarter of an inch. Step on the footswitch and maintain the flow of current until a distinct ring of bleached tissue appears on the surface of the meat surrounding the point of insertion. With this power setting, blanching will occur in two or three seconds. Do not allow the current to remain on until sparking occurs at the active electrode.

Turn off the current by releasing the footswitch and withdraw the electrode. Cut a section through the blanched circle and observe the tissue change which has taken place. You will find that you have produced an inverted cone of coagulum and extending beyond the depth of electrode insertion.

Next, try applying low power for a longer time. Set the power control for about 20 percent of the output, insert the electrode to the same depth and apply the current until blanching is obvious. With this low power, this will probably require fifteen seconds or more. On sectioning the meat this time, you will see a more extensive mass of coagulum extending farther away from the electrode and penetrating more deeply.

You have now demonstrated two methods of electrocoagulation; first, the application of high power for a short time to produce limited, accurately controlled tissue destruction and, second, the application of low power for a longer time to produce more massive coagulation with a single insertion of the electrode. Obviously, the first method is generally preferable in the interest of conservatism, accuracy and time saving. For coagulation of massive areas, multiple punctures at high power are considered usually more desirable than a single or fewer punctures at low power and the longer time required.

Insert different sizes of needles to different depths, varying the amount of power and noting the time required to produce a ring of blanched tissue around the electrode. With attentive examination of the sections, you will soon gain an understanding of the amount of coagulation to be expected from various amounts of power with different depths of insertion of heavier or finer electrodes for varied periods of time.

To achieve controlled superficial destruction, try "brushing" the surface of the meat with a ball electrode over a predetermined area. Section and note the depth of penetration as evidenced by the blanching. Vary the amount of power and speed of moving the ball, noting on sections how the depth of destruction can be varied from a few thousandths of an inch to any moderate depth required.

The destruction of small particles of tissue may be demonstrated by hooking a curved electrode into a small tab of meat. With a moderate power setting, turn the current on in short flashes until the entire tab is dehydrated as indicated by the blanching.

c. EXPERIMENTS WITH FULGURATION AND DESICCATION

Using a pointed electrode (preferably the heavy skin needle), allow a stream of sparks one or two mm. long to play from the point to the meat. Try this with and without the indifferent plate and when the indifferent electrode is not used, hold the meat in your left hand to add the capacitance of your body which will simulate actual treatment conditions. The spray of sparks will dehydrate the superficial layers of tissue quite rapidly and you will find that the depth of destruction is self-limiting because complete surface dehydration will insulate the current against further penetration. Some variation in depth of penetration can be accomplished by varying the power and you will note that you will use one-half the power setting for bipolar fulguration as is required for monopolar applications.

Now, continue to hold the meat and try monopolar desiccation by touching the needle point to the meat and then by inserting it slightly. You will see that desiccation will produce deeper penetration than fulguration but that it, too, by virture of its monopolar character is quite superficial and self-limiting.

Your experience with these two applications of high-frequency dehydration will demonstrate their particular usefulness in skin conditions.

d. EXPERIMENTS WITH ELECTRO-CUTTING

Use of the cutting current requires more understanding and skill than the purely dehydrating currents. The physician will wisely familiarize himself with the "feel" of the cutting current, the synchronization of hand and foot in the manipulation of the electrode

and footswitch, the proper selection and application of electrodes, and the selection of power settings suitable to the technic being employed.

Application of the cutting current is always bipolar. In preparation for cutting experiments, therefore, the indifferent electrode is again connected to the "patient" terminal of the Bovie and the meat placed upon it. Set the selector switch on "cutting" and insert the electrode into the chuck handle which should be connected to one of the active terminals of the machine.

For the first experiment, use a flat blade electrode. The flat blade should always be used for a "clean" incision which will heal by primary union if you do not cut too slowly. Set the power control at about one third of the total. Place the tip of the electrode lightly in contact with the meat and as you step on the footswitch, draw the electrode through the tissue at about the same speed you would use for cutting with a scalpel. Note that the current does the cutting, carrying the electrode through the tissue with almost complete lack of resistance "feel" of the cold scalpel.

Lift your foot at the exact moment you complete the cut and lift the electrode from the tissue. This synchronization is important. If the current is turned off too soon, the cut will be incomplete; if too late, electrical arcing will follow the electrode from the tissue, causing extra dehydration at that point. Similarly, unless the electrode starts to move immediately after the current is turned on, there will be a wider depth of dehydration at the start of the incision.

Vary the depth of cut -- increasing the power setting for deepest cutting; using less power for shallow incisions -- and try stopping and starting to practice hand and foot synchronization.

Now, repeat the above experiments, substituting a needle electrode for the flat blade. The needle, presenting a thicker cutting edge, will produce greater dehydration on the edges of the incision, with more resistance and, consequently, slower cutting at the same power setting. A needle electrode is preferred for incising abscesses or cysts where drainage is desirable and healing by first intention is to be prevented by choice. Try short cross incisions, a type of incision used particularly for abscess or cyst.

Next, try "scalloping" out bits of tissue or looping off simulated neoplasms with a loop electrode. Use about 40 percent of power output to begin with. Contact the tissue lightly with a small section of the loop before turning on the current. Step on the footswitch and start movement of the loop immediately. If too much of the loop contacts the tissue or if you wait too long with current on before moving the loop, coagulation will retard or prevent cutting. Cut into, through, and out of the tissue. It is quite an art to bring the loop away from the tissue with the piece completely excised. The final thin tab of tissue will resist severance unless the loop is handled just right. Practice makes perfect.

The wire of the loop electrodes will permit shaping to desired shapes other than round, or bending to various angles; so there is no need to be equipped with loops of varied shapes or angulation.

SECTION IV - SERVICE AND MAINTENANCE

17. MAINTENANCE

a. CARE OF MACHINE

(1) When not in use, the machine should be kept clean and covered.

(2) For best performance, the gap adjustment should be made each day before operations are started. While the gaps will, under ordinary circumstances, retain their adjustment over quite a period of time, they may get slightly out of adjustment if the machine is moved around or jolted, and for assurance of satisfactory performance, a complete gap adjustment is recommended each day before starting to work.

(3) When the gaps become worn or pitted enough to interfere with proper operation, or to make adjustment difficult, they should be replaced. However, in an emergency, gaps may be cleaned and resurfaced to allow some further use.

(4) To clean spark gaps, obtain a strip of #000 sandpaper. Fold this strip so that there is an abrasive on both sides. Open the spark gaps by turning the spark gap adjustment knob counterclockwise until the folded strip of sandpaper can

be placed between the gap surfaces, and then close the gaps until a slight friction on the sandpaper is felt. Carefully draw the sandpaper between the gaps a few times.

(5) After cleaning the gaps, make certain that any grit that may have been left between the gaps is removed. This can be done by drawing a clean strip of paper through the gaps in exactly the same manner as the sandpaper.

b. IF UNABLE TO MAKE GAPS FIRE

(1) Make sure machine is connected to correct power line supply - check both voltage and frequency.

(2) Check fuses in machine. Spare fuses are stored in a plastic bottle in the right-hand compartment of the machine.

(3) Make sure that the supply line is not "dead" because of burned out fuses or other reasons. Pilot light will glow when machine is connected to proper supply current and selector switch is on "Scalpel" or "Coagulation" position. If pilot light does not glow, look for trouble in the supply line.

(4) See that footswitch is connected.

(5) See that current selector is on "Scalpel" or "Coagulation" position.

(6) Occasionally some unauthorized person may start to "play" with the machine and close one or more gaps several turns or open them up a number of turns. If this occurs, it may appear impossible to get the gaps to fire.

(a) The first thing to do is to close all gaps completely by turning each adjustment knob clockwise until resistance is felt. This may require anywhere from two or three to twenty or thirty turns depending on whether gap is partially open or closed at the start.

(b) After all gaps are completely closed, proceed to adjust gaps in accordance with the instructions given in Section III, Paragraph 9.

c. IF MACHINE DOES NOT CUT PROPERLY, check the following points.

The chances for any electrical or mechanical failure on the part of the machine are so remote that if, on trial, it apparently will not cut, it is likely that some important point in the preparation has been overlooked. Recheck all the following points and <u>be sure</u>:

1. That the machine is connected to correct current supply.

2. That current supply is alive. Be sure to have fuses of sufficient capacity on your supply line to carry the Bovie as well an any other load that may be on the line at the same time. Check fuses in the machine also.

3. That Current Selector is on "Scalpel" position.

4. That all spark gaps are correctly adjusted and firing with equal intensity, without sputtering or irregular operation.

5. That high frequency cord from operating electrode is connected to the machine.

6. That indifferent electrode is firmly in contact with Patient's bare skin and connected to the machine.

7. That power control is properly set.

8. If cutting is under water, see Section III, Paragraph 13.

18. PARTS REPLACEMENT

Replacement of parts in the field should be limited to parts that require little technical knowledge to accomplish. Otherwise, return the unit for repair. Following is a list of parts which are easily replaced with notes on how to replace them:

a. FUSES. Four fuse holders are located on the right rear portion of the control panel.

TO REPLACE FUSES:

(1) Push down on fuse cap - rotate 1/4 turn counterclockwise and lift out. Fuse comes out with cap.

(2) Remove burned out fuse by pulling out of cup shaped clip. Discard.

(3) Spare fuses are stored in a plastic bottle in the right hand compartment.

(4) Place new fuse of proper rating (10 amperes or 20 amperes) in cup of removable cap. Push in until fuse seats against end of cup.

(5) Replace fuse and cap assembly in fuse holder - push down and rotate 1/4 turn clockwise to lock cap in place.

b. PILOT LAMP. To replace Pilot Lamp:

(1) Grasp transparent pilot light dome cover and unscrew by rotating counterclockwise.

(2) Unscrew and remove old Pilot Lamp. If lamp is difficult to turn or lift out, a piece of scotch tape, surgical tape or friction tape can be pressed against glass bulb to assist removal.

(3) Spare pilot lamps are stored in a plastic bottle in the right-hand compartment.

(4) Install new lamp and replace dome cover. Seat both lamp and cover firmly.

c. SELECTOR SWITCH HANDLE HOLDER

(1) To remove:

(a) Unscrew set screw in base of holder with screw driver.

(b) Pull handle holder off shaft.

(2) To replace:

(a) Replace holder on shaft in same position.

(b) Insert and tighten set screw.

d. POWER CONTROL HANDLE HOLDER

(1) To remove:

(a) Loosen set screw using 3/32" Allen Wrench.

(b) Pull handle holder off shaft.

(2) To replace:

(a) Replace holder on shaft in same position.

(b) Tighten set screw, using 3/32" Allen Wrench.

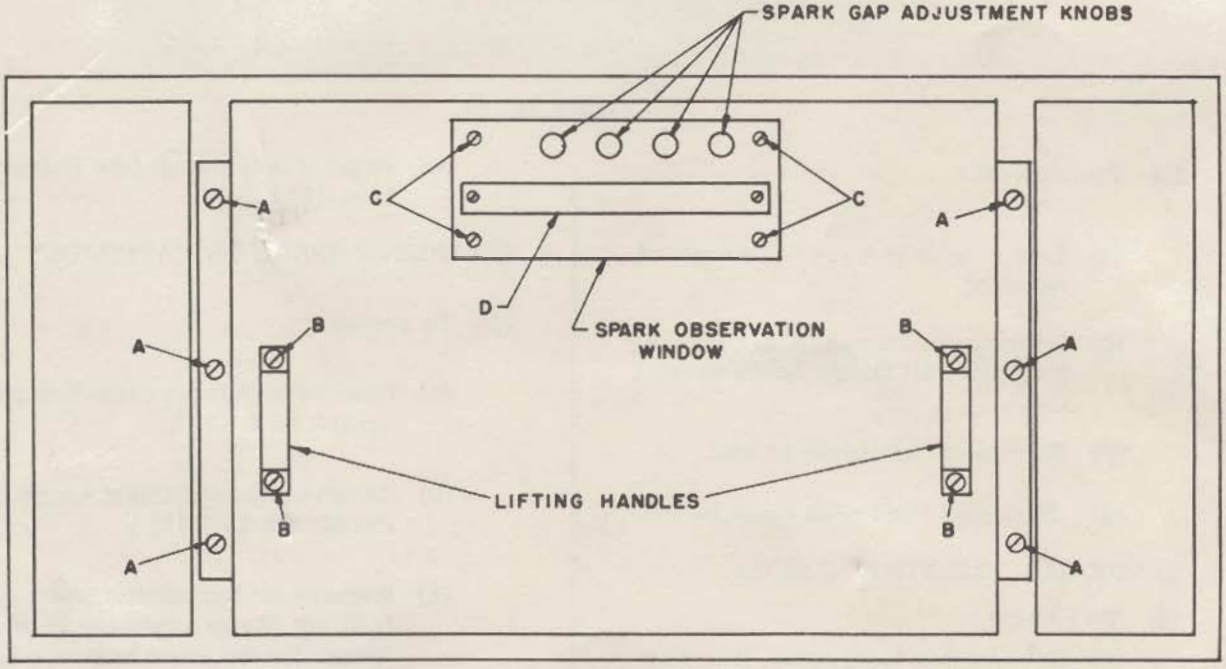


Figure 9

e. TO REMOVE UNIT FROM CASE

(1) To remove:

(a) Disconnect footswitch cable from unit.

(b) Disconnect line cable from unit.

(c) Remove six screws marked A in figure 9.

(d) **Lift unit from case using the two lifting handles.**

(b) Loosen set screw on top part of flexible coupling, holding adjustor knob to prevent turning. (See fig.10)

(c) Lift knob and shaft out through top panel.

(2) To replace:

(a) Insert knob through top of panel and align flat on shaft with set screw.

(b) Tighten set screw.

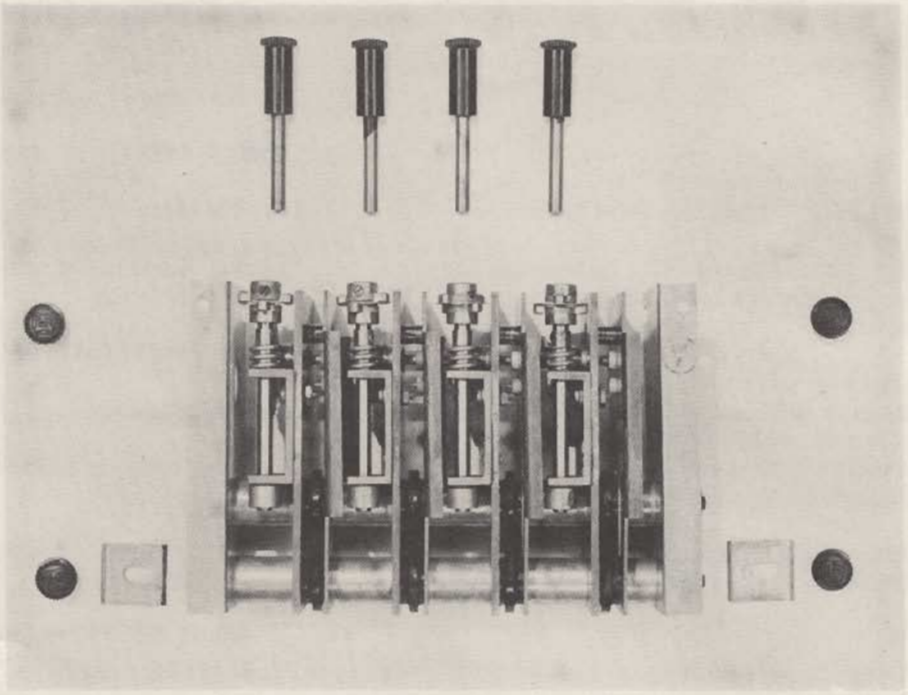


Figure 10

(2) To replace:

(a) Lower unit in case by means of handles.

(b) Replace six screws (A in figure 9). Tighten until flange seats against case.

(c) Reconnect line cable to unit.

(d) Reconnect footswitch cable to unit.

f. SPARK GAP ADJUSTMENT KNOB

(1) To remove:

(a) Remove unit from case. (See Paragraph 18-e-(1)).

(c) Replace unit in case (See Paragraph 18-e-(2)).

g. COMPLETE SPARK GAP ASSEMBLY

(1) To remove:

(a) Remove unit from case (See paragraph 18-e-(1)).

(b) Remove gap adjustment knobs (See Paragraph 18-f-(1)).

(c) Remove the two bakelite knobs which hold top of gap assembly in place, loosen the two lower knobs and slide clips outward.

(d) Grasp gap assembly firmly with both hands, pull back until gap clears top holding screws, rotate top toward you to an angle of about 45°, then pull up and out.

(2) To replace:

(a) Insert gap assembly into place in the reverse of 18-g-(1)-(d) above.

(b) Replace the four bakelite knobs, their clips and washers. Tighten firmly.

(c) Replace gap adjustment knobs (See Paragraph 18-f-(2)).

(d) Replace unit in case (See Paragraph 18-e-(2)).

h. SPARK OBSERVATION WINDOW

(1) To remove:

(a) Remove unit from case (See Paragraph 18-e-(1)).

(b) Remove all gap adjustment knobs (See Paragraph 18-f-(1)).

(c) Remove Selector Switch Handle Holder (See Paragraph 18-c-(1)).

(d) Remove Power Control Handle Holder (See Paragraph 18-d-(1)).

(e) Remove lifting handles by removing four screws marked B in figure 9.

(f) Remove plate marked D from observation window. (See figure 9).

(g) Lift off cover and remove observation window by removing four screws marked C on figure 9. These screws are held on with nuts under the cover.

(2) To replace:

(a) Attach window to cover with four screws (C in figure 9).

(b) Fasten plate D to window with two screws.

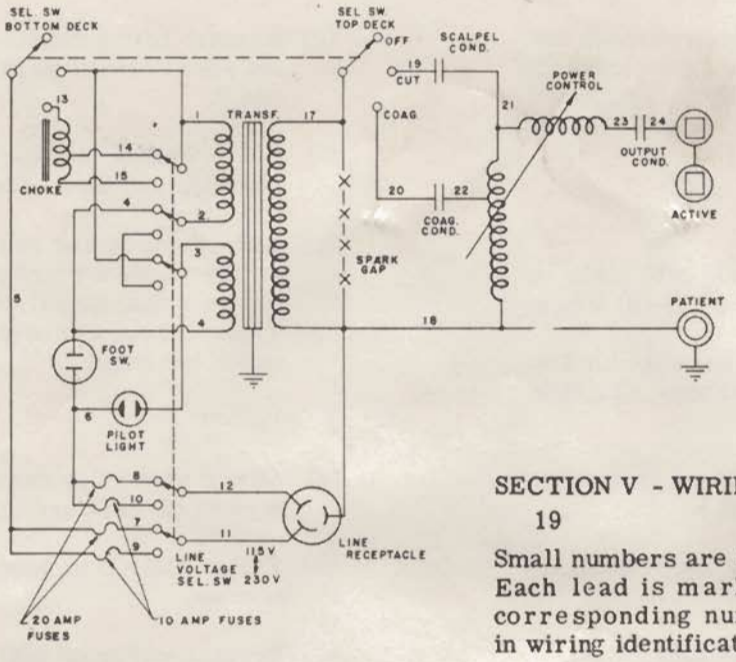
(c) Replace cover on unit and fasten on by attaching lifting handles with the 4 screws marked B in figure 9.

(d) Replace Power Control Handle Holder (See Paragraph 18-d-(2)).

(e) Replace Selector Switch Handle Holder (See Paragraph 18-c-(2)).

(f) Replace gap adjustment knobs (See Paragraph 18-f-(2)).

(g) Replace unit in case (See Paragraph 18-e-(2)).



SECTION V - WIRING DIAGRAM

19

Small numbers are lead numbers Each lead is marked with its corresponding number to aid in wiring identification.

SECTION VI - PARTS LIST

20. ACCESSORIES

CAT. NO.	DESCRIPTION	FIGURE NUMBER
LF 15 LO 105	HANDLE, small chuck type.	3-9
LF 15 LO 423	ELECTRODE, straight point stainless steel.	3-20
LF 15 LO 426	ELECTRODE, curved point stainless steel.	3-21
LF 15 LO 338	ELECTRODE, medium cervical conization.	3-19
LF 15 LO 94	CORD, round end patient.	3-6
LF 15 LO 210	PLUG, active Bovie adaptor.	3-5
LF 15 L 134	HANDLES, sterilizable.	3-4
LF 15 LO 532	ELECTRODE, large stainless steel indifferent.	3-1
LF 15 LO 531	ELECTRODE, small stainless steel indifferent.	3-2
LF 15 LO 13	ELECTRODE, fine needle with 7/8" insulated shank.	3-10
LF 15 LO 12	ELECTRODE, coarse needle with 7/8" insulated shank.	3-11
LF 15 LO 500	ELECTRODE, small straight blade with 7/8" insulated shank.	3-15
LF 15 LO 501	ELECTRODE, large straight blade with 7/8" insulated shank.	3-16
LF 15 LO 503	ELECTRODE, small angulated blade with 7/8" insulated shank.	3-14
LF 15 LO 44	ELECTRODE, 1/4" round loop with 7/8" insulated shank.	3-12
LF 15 LO 45	ELECTRODE, 5/16" round loop with 7/8" insulated shank.	3-13
LF 15 LO 97	ELECTRODE, 1/8" ball 1-3/4" insulated shank.	3-17
LF 15 LO 98	ELECTRODE, 3/16" ball with 1-3/4" insulated shank.	3-18
LF 15 LO 288	*GRIP, OFFSET, for long chuck type handle.*	*3-8*
LF 15 LO 286	HANDLE, long chuck type.	3-7
LF 16 LO 127	FOOTSWITCH, Single Treadle	2-4
LF 210 LO 302	CABLE, LINE, 15 feet.	2-1
LF 306 L 334	GROUNDING LEAD, short	2-2
LF 306 LO 333	GROUNDING LEAD, long	2-3
LF 210 L 387	BOTTLE, large plastic.	3-3
LF 44 L 128	FUSE, 10a 250-v., type 3AB	3-22
LF 210 L 329	FUSE, 20a 250-v., type 3AB	3-22
LF 206 L 25	PILOT LAMP, 1/4w. 120-v. candelabra base neon lamp.	3-23

21. UNCOMMON PARTS (Parts fabricated especially for stock No. 6515-327-5600)

LF 98 LO 213	HANDLE HOLDER, for Selector Switch	-
LF 89 LO 317	HANDLE HOLDER, for Power Control.	-
LF 209 LO 51	KNOB, spark gap adjusting	10
LF 209 LO 262	SPARK GAP ASSEMBLY	10
LF 98 LO 17	INSULATED NUT, for attaching spark gaps.	10

21. UNCOMMON PARTS (Parts fabricated especially for stock No. 6515-327-5600) Cont'd.

CAT. NO.	DESCRIPTION	FIGURE NUMBER
LF 210 L 318	CLIP, for attaching spark gaps.	10
LF 210 L 7	WINDOW, plastic, for viewing spark gaps.	
LF 210 LO 200	CASE, body portion.	
LF 210 LO 240	CASE, cover.	
LF 210 LO 100	CHASSIS	
LF 210 LO 1	CHASSIS, cover	
LF 210 L 336	HANDLE, for chassis cover	
LF 210 LO 389	LATCH AND FUSE HOLDER ASSEMBLY	
LF 210 LO 390	LINE VOLTAGE SELECTOR SWITCH ASSEMBLY	
LF 210 LO 417	OUTPUT TERMINAL BOARD ASSEMBLY	
LF 210 L 315	SPACER, for output terminal board, coagulation condenser, & output condenser	
LF 209 L 69	NUT, for output terminal board attachment.	
LF 210 L 340	BRACKET, for pilot light.	
LF 210 L 313	SOCKET ASSEMBLY, with pilot light.	
LF 89 L 245	SUPPLY RECEPTACLE, Hubbel Cat. No. 7556	
LF 210 L 314	FOOTSWITCH RECEPTACLE, Hubbel Cat. 7526	
LF 210 LO 392	BRACKET, RH, for spark gap	
LF 210 LO 391	BRACKET, LH, for spark gap	
LF 210 L 319	SUPPORT, LOWER, for spark gap	
LF 210 L 320	BRACKET, LOWER, for spark gap	
LF 87 LO 5	SELECTOR SWITCH AND SCALPEL CONDENSER ASSEMBLY	
LF 210 LO 421	VARIOMETER ASSEMBLY	
LF 210 LO 373	CHOKE COIL	
LF 210 LO 385	MAIN TRANSFORMER	
LF 210 LO 312	COAGULATION CONDENSER	
LF 209 LO 11	OUTPUT CONDENSER	
LF 209 L 2	CLAMP, CABLE	
LF 210 L 378	INSULATOR, for condenser	
LF 210 LO 431	TERMINAL BOARD and LEAD ASSEMBLY, for primary circuit	
LF 210 L 409	INSULATOR	

22. COMMON PARTS (Parts not especially fabricated for stock No. 6515-327-5600)

NO. REQUIRED	DESCRIPTION
13	#8 x 3/8" Sheet Metal Screw, steel, cadmium plated
6	8-32 x 5/8" FHMS, steel, bright zinc plated
9	8-32 x 3/8" RHMS, steel, bright zinc plated
5	8-32 x 1/2" RHMS, steel, bright zinc plated
2	8-32 x 1/2" BHMS, brass
22	8-32 Hex Nuts, steel, bright zinc plated
8	8-32 Hex Nuts Brass
25	#8 Split Steel Lock washers, bright zinc plated
20	#8 Flat Washer, brass
2	10-32 x 3/8" RHMS, steel bright zinc plated
8	10-32 x 1/2" BHMS, steel bright zinc plated
8	10-32 x 1-1/4" RHMS, steel bright zinc plated
4	10-32 x 1-3/8" RHMS, steel, chrome plated
24	10-32 Hex Nuts, bright zinc plated
26	#10 Split Steel Lock Washer, bright zinc plated
8	#10 Flat Washer, Brass
3	1/4-20 Hex Nuts, brass
3	1/4" Split Steel Lock Washers, bright zinc plated
6 ft.	WIRE, primary, 16 ga., 600-v 105° C Plastic insulated
10 ft.	WIRE, secondary, GTO-10, 14 ga. neon sign wire
8	8-32 x 1-1/8" RHMS, steel, bright zinc plated
1	10-32 x 3/16" Allen Set Screw, steel, bright zinc plated
4	8-32 x 1" BHMS, Brass
4	10-32 Hex Nut, Brass
2	#6 x 1/4" Sheet Metal Screw, steel, cadmium plated
2	#6 x 3/8" Sheet Metal Screw, steel, cadmium plated